



Mountain Safety Research – MIOX[®] Purifier

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Device Information

The Mountain Safety Research (MSR[®]) MIOX[®] Purifier is a device that produces a disinfectant through the electrolysis of a brine solution. The device is similar to a large magic marker (it is commonly referred to as the MIOX[®] Pen). The device uses electricity provided by batteries and a brine solution provided by wetted rock salt to produce a disinfectant. The disinfectant produced by this process is chlorine. There is speculation that other short-lived oxidants may be produced by this process, however, the most current scientific information indicates that only chlorine is produced (reference 1). The chlorine produced by the device is then added to the water to be treated. There is a military and civilian version of this device. Device operation of both versions is identical. The only difference is the packaging and appearance. The military version is black and tan colored and comes in a nylon carrying case. The civilian version is black and red and comes with a mesh/nylon drawstring bag. Both devices come with two batteries, a packet of rock salt, and a container with 50 chlorine residual test strips. Prior to use the batteries must be installed and rock salt added to the device's salt chamber. Directions call for addition of water to the device's reaction cell and mixing that water with the salt in the salt chamber to produce a brine solution in the reaction cell. The device is activated, passing a current through the brine solution in the reaction cell (which contains an anode and cathode). This causes electrolysis of the brine solution and production of chlorine. This chlorine solution is then added to the water to be treated. The user then tests the water being treated with a chlorine residual test strip to ensure the minimum dose of 4 mg/L is achieved. If the minimum dose is not achieved, the user is directed to continue adding additional chlorine doses and checking the chlorine residual until a minimum 4 mg/L chlorine dose is obtained. Ten minutes after adding the chlorine to the water, the user is directed to check chlorine residual again. If not adequate (i.e., at least 4 mg/L) the water must be dosed again. Once the adequate dose of chlorine is added to the water, the user is required to wait a total of 30 minutes for adequate bacteria, virus, and *Giardia* cyst reduction. The manufacturer also recommends an "overkill option" – if test strips are unavailable or the situation dose not allow for the test procedure, the user may overdose the water 8X instead. To do so, use two 4 L doses per 1 L of water and wait 30 minutes, after which even the "worst case" water will be ready to drink. The manufacturer

[®] MIOX is a registered trademark of MIOX Corporation, Albuquerque, NM.

[®] MSR is a registered trademark of Mountain Safety Research, Inc., Seattle, WA. Use of a trademarked product does not imply endorsement by the U.S. Army, but is intended only in identification of a specific product.

also makes a special note regarding *Cryptosporidium* treatment – in all cases, using test strips or overkill, treating water contaminated with *Cryptosporidium* requires a 4-hour wait time. The manufacturer does not provide any storage requirements.

Effectiveness Against Microbial Pathogens

Independent testing using the U.S. Environmental Protection Agency (USEPA) Guide Standard and Protocol for Testing Microbiological Water Purifiers confirms this product met the minimum 6-, 4-, and 3-log inactivations for bacteria, viruses, and *Giardia* cysts when used according to directions (i.e., at least a 4 mg/L chlorine dose and 30 minute wait time) (references 2,3). Using the MIOX[®] Purifier according to directions results in a minimum disinfectant concentration times contact time (CT) of 120 mg-min/L. The directions also describe an overkill option and special treatment instructions for *Cryptosporidium*. The overkill option results in a dose of at least 32 mg/L (8X normal 4 mg/L dose) and a wait time of 30 minutes. This corresponds to a CT of 960 mg-min/L. The special treatment instructions for *Cryptosporidium* result in two different doses; one being at least 4 mg/L (when using test strips) and the other dose being at least 32 mg/L (using overkill option). Regardless of dose, the wait time is the same 4 hours for both. These doses and wait times correspond to CTs of 960 mg-min/L and 7,680 mg-min/L, respectively. There is independent testing using the USEPA Protocol challenging the MIOX[®] Purifier with *Cryptosporidium* oocysts (reference 3). That data shows the MIOX[®] Purifier consistently provided a 3-log *Cryptosporidium* reduction at only the higher, overkill dose and 4-hour wait time (i.e., CT of 7,680 mg-min/L). Other device specific test data (that was uncertain if the USEPA Protocol was used) indicated the MIOX[®] Purifier was not able to consistently provide a 3-log *Cryptosporidium* reduction when using the lower dose (4 mg/L when using the test strips) and 4-hour wait time. Since the directions imply that the MIOX[®] Purifier can provide adequate *Cryptosporidium* reduction when using the test strips (i.e., a 4mg/L dose) and waiting 4 hours when the device-specific test data does not support this, the MIOX[®] Purifier must be considered to not be able to consistently provide a 3-log *Cryptosporidium* reduction when used as directed. When using this device, always using the overkill option dose (8X normal dose) and waiting 4 hours will ensure adequate *Cryptosporidium* reduction. Based on independent data, testing the device under severe conditions required by the USEPA protocol and other device-specific testing data, the MSR[®] MIOX[®] Purifier is given three √s for effectiveness against bacteria, viruses, and *Giardia* cysts, and an X for effectiveness against *Cryptosporidium* oocysts (for an explanation of the rating checks [click here](#)). The following table summarizes the device's expected performance, evaluation rating, and the mechanism by which pathogens are inactivated:



Table. Expected Performance Against Microbial Pathogens When Used as Directed.

Microbial Pathogen Type	Expected Disinfection Capability	Evaluation Rating	Inactivation/removal Mechanism
Bacteria	> 6-log	√√√	disinfection
Viruses	> 4-log	√√√	disinfection
<i>Giardia</i> cysts	> 3-log	√√√	disinfection
<i>Cryptosporidium</i> oocysts	Not Effective*	X*	-

* Using the overkill option dose (8X the normal dose) and waiting 4 hours will ensure adequate *Cryptosporidium* reduction.

Production Capacity

As purchased, the manufacturer states the production capacity is approximately 200 L. This capacity is based on the amount of salt provided.

Cleaning, Replacement, End of Life Indicator, Shelf life

No device cleaning is required. Batteries, rock salt, and chlorine residual test strips will need replacement. The chlorine residual test strips have an expiration date, although shelf life could not be determined. A low battery indicator acts as an end of life indicator. The chlorine test strips serve as a device failure indicator.

Weight and Size

The total weight of the device, rock salt, batteries, and chlorine residual test strips is approximately 230 grams. The dimensions of the device and components in the provided carrying case are approximately 17 cm x 9.5 cm x 3.5 cm (H x L x W).

Cost

Civilian version	\$130.00
Chlorine test strips and salt (sodium chloride)	\$ 18.00
Lithium Batteries, 2 pack	\$ 13.00



COTS Purifiers – Army Study Program, Project No. 31-MA-03E0-05.

Military version (NSN 4610-01-513-8498)	\$107.00
Sodium chloride (NSN 6810-01-513-8737)	\$ 3.00
Replacement MIOX [®] Purifier (NSN 4460-01-518-5095)	\$ 72.00
Replacement carrying case (NSN 4460-01-518-5099)	\$ 17.00
Chlorine test strips (NSN 6550-01-516-4933)	\$ 9.00
Battery, 12 pack (NSN 6135-01-351-1131)	\$ 28.00

Device Evaluation

Independent testing using the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers confirms the MSR[®] MIOX[®] Purifier met the minimum 6-, 4-, and 3-log inactivations for bacteria, viruses, and *Giardia* cysts when used as directed (at least a 4 mg/L chlorine dose and 30-minute wait time) (references 2 and 3). The MSR[®] MIOX[®] Purifier is not considered to consistently provide a 3-log *Cryptosporidium* reduction when used as directed due to discrepancies with the special *Cryptosporidium* treatment instructions and device-specific testing confirming the device meets a 3-log *Cryptosporidium* reduction for only the overkill dose and 4-hour wait time. The use of the chlorine test strips is critical to proper device operation and water treatment. The device-specific test data indicated significant variability in production of chlorine doses. For example, one test using three separate devices required in the range of 4-5 initial chlorine doses to achieve at least a 4 mg/L chlorine dose in a clean (low oxidant demand) water. Compared to other disinfectants, this device is more complicated and requires more effort to use. However, a limited military assessment was conducted in which soldiers indicated the device was easy to use and required minimal training. The assessment also indicated the device is durable. When used as directed, the device will expose the user to chlorine and may expose the user to disinfection byproducts such as trihalomethanes and haloacetic acids when chlorine reacts with naturally present organic matter. However, when used as directed for short periods of time, exposure to these compounds is not expected to cause adverse health effects in healthy adults (reference 1). The device can impart a chlorine taste and odor to the water being treated. The device will not remove or reduce particulate matter.

Advantages

- Independent testing using the USEPA Protocol confirms the device consistently provides 6-log bacteria, 4-log virus, and 3-log *Giardia* cyst reduction when used as directed.
- Small and lightweight.
- Inexpensive to use.
- No adverse health effects expected in healthy adults from short-term use.



Disadvantages

- Does not consistently provide adequate *Cryptosporidium* reduction when used as directed. Using the overkill option dose (8X normal dose) and waiting 4 hours will ensure adequate *Cryptosporidium* reduction.
- Does not reduce or remove particulate matter.
- Can impart chlorine taste and odor.

References

1. U.S. Army Center for Health Promotion and Preventive Medicine. (2005). *Technical Information Paper; Chlorine Disinfection in the Use of Individual Water Purification Devices*, Aberdeen Proving Ground, MD.
2. U.S. Environmental Protection Agency, Registration Division Office of Pesticide Program, Criteria and Standards Division Office of Drinking Water. (1987). *Guide Standard and Protocol for Testing Microbiological Water Purifiers*. Washington, D.C.
3. Independent testing data provided by MSR[®] and MIOX[®].

